ARTIFICIAL INTELLIGENCE IN THE EDUCATION OF HEALTH PROFESSIONS: A DESCRIPTIVE ANALYSIS THROUGH BIBLIOMETRICS

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Abstract

Introduction and Objectives: Artificial intelligence (AI) refers to a branch of computer science that focuses on creating machines and software programs that can perform tasks that typically require human-like intelligence, such as learning, problem-solving, decision making, and language understanding. AI technologies include machine learning, deep learning, natural language processing, and computer vision, among others. AI has applications in various fields, including healthcare, finance, education, among others, and has the potential to transform how we live, work, and interact with technology. AI has the potential to revolutionize the education of healthcare professionals by providing new tools and resources for teaching and training, such as personalized learning, intelligent tutoring, virtual simulation, and automated grading. The use of AI in healthcare education is growing, and it has the potential to impact research as well. However, the vast amount of scientific literature in this field makes it challenging to understand its scientific structure and development. Visualization techniques based on bibliometric data can be helpful in comprehending scientific fields. Material and Methods: This is a bibliometric, descriptive, and retrospective study. The author identified publications from the Pubmed database from 1990 till 2023 related to the use of Artificial Intelligence in Health Professions Education using this search string (AI OR "Artificial Intelligence"[Mesh]) AND "Education"[Mesh] AND "Health Personnel"[Mesh]. From the titles and abstracts of these publications, was selected the main terms related to the field, extracted by VOSviewer software, to create a visualization of the most important trends referred to in the literature. Results: The researchers identified a total of 576 relevant references, including 36 clinical trials and randomized controlled trials, as well as 57 meta-analyses and systematic reviews. Upon examining the co-occurrence of Mesh terms associated with AI and healthcare professionals' education, it was found that the most common usage of this approach was in various medical fields and educational levels, followed by allied health personnel. Another noteworthy observation was the emergence of the use of AI in healthcare education in surgery, which began to gain traction after 2018. Conclusions: Overall, as shown by published research, the interest in AI has grown exponentially, influencing all aspects related to the use of this approach in the education and training of healthcare professions. The use of AI in healthcare education has the potential to enhance the learning experience for students, improve their clinical skills and decision-making abilities, and ultimately lead to better patient outcomes. However, it is important to ensure that these technologies are designed and implemented in an ethical and responsible manner, with appropriate consideration given to issues such as bias, privacy, and transparency.

Keywords: Artificial Intelligence, Health Professions, Bibliometrics.

1 INTRODUCTION

Artificial intelligence (AI) refers to a branch of computer science that focuses on creating machines and software programs that can perform tasks that typically require human-like intelligence, such as learning, problem-solving, decision making, and language understanding. AI technologies include machine learning, deep learning, natural language processing, and computer vision, among others. AI has applications in various fields, including healthcare [1], finance, education, among others, and has the potential to transform how we live, work, and interact with technology.

Artificial intelligence (AI) possesses the capacity to revolutionize the education of healthcare professionals by offering innovative tools and resources for teaching and training [2]. The following are some potential applications of AI in healthcare education:

- Personalized Learning: AI can facilitate a customized learning experience for individual students by providing tailored recommendations for study materials, assignments, and assessments based on their specific learning needs, preferences, and progress. AI-driven adaptive learning platforms

can modify the pace and difficulty of learning activities to correspond with the student's level of understanding and supply targeted feedback to enhance their performance [3].

- Virtual Simulation: AI-powered virtual simulation tools can generate realistic scenarios that allow healthcare professionals to practice clinical skills and decision-making in a secure and controlled environment [4]. This can be particularly valuable for high-risk procedures or situations that may be challenging to replicate in real-world settings.

- Intelligent Tutoring: AI-based intelligent tutoring systems can deliver real-time feedback and guidance to students as they learn, assisting them in identifying areas requiring additional support and providing targeted resources to address their knowledge gaps [5].

- Automated Grading: AI algorithms can be employed to automatically grade assessments and provide feedback to students, saving instructors time and facilitating more frequent and timely assessments [6].

- Data Analytics: AI can be utilized to analyse student data and identify patterns and trends in their learning and performance. This can aid instructors in recognizing areas where students are struggling and adjusting their teaching methods accordingly [7].

In summary, the incorporation of AI in healthcare education has the potential to enrich the learning experience for students, improve their clinical skills and decision-making abilities, and ultimately contribute to better patient outcomes. However, it is crucial to ensure that these technologies are designed and implemented in an ethical and responsible manner, with due consideration given to issues such as bias, privacy, and transparency [8].

The application of artificial intelligence (AI) in health professions education continues to expand, potentially influencing research as well. Nonetheless, the proliferation of scientific publications in this area presents challenges in comprehending the field's scientific structure and development. Employing visualization techniques based on bibliometric data can facilitate a better understanding of these scientific domains.

Bibliometrics, is an academic discipline that examines patterns and trends within research literature by utilizing statistical and mathematical methods to analyse and assess the impact of research papers and other scholarly works. Often, bibliometric studies serve to gauge the productivity and influence of research within a specific field or institution, thereby informing decisions related to funding, hiring, and promotion [9].

A variety of metrics may be employed in bibliometric studies, such as:

- Citation count: A metric quantifying the number of times a particular paper has been cited by other papers.

- Impact factor: A metric representing the average number of citations received by papers published in a specific journal.

- H-index: A metric evaluating an author's productivity and impact based on the number of papers they have published and the subsequent citations those papers have garnered.

- Co-citation analysis: An analytical process examining co-citation patterns (i.e., papers cited together) to pinpoint key research areas and trends.

Bibliometric studies prove valuable for several objectives, including the identification of influential research within a specific field, the recognition of research gaps in the literature, and the evaluation of research funding impact. However, it is crucial to acknowledge that bibliometric measures represent only one approach to research evaluation and should be employed alongside other methods [10].

2 METHODOLOGY

This study is a bibliometric, descriptive, and retrospective analysis of publications related to the use of Artificial Intelligence (AI) in Health Professions Education. The author conducted a comprehensive literature search in the PubMed database, spanning from 1990 to 2023, using the following search string: (AI OR "Artificial Intelligence"[Mesh]) AND "Education"[Mesh] AND "Health Personnel"[Mesh]. This search aimed to identify relevant publications that discuss the application of AI in the context of educating healthcare professionals.

Following the identification of these publications, the author reviewed the titles and abstracts to extract the main terms and concepts related to the field. This process was carried out using VOSviewer software, a tool specifically designed for bibliometric mapping and visualization. By utilizing this software, the author was able to create a visual representation of the most important trends and themes mentioned in the literature.

3   RESULTS

The researchers identified a total of 576 relevant references, including 36 clinical trials and randomized controlled trials, as well as 57 meta-analyses and systematic reviews (Fig.1).
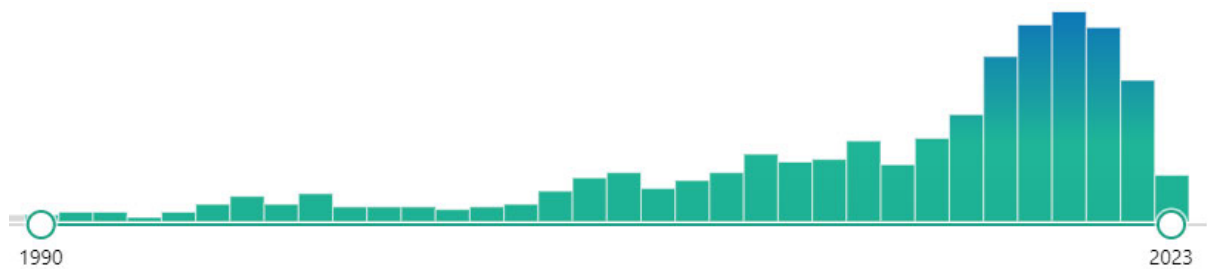

Figure 1. Publications identified in Pubmed database from 1990 to 2023

Upon examining the co-occurrence of Mesh terms associated with AI and healthcare professionals' education, it was found that the most common usage of this approach was in various medical fields and educational levels, followed by nursing and allied health personnel (Fig.2)
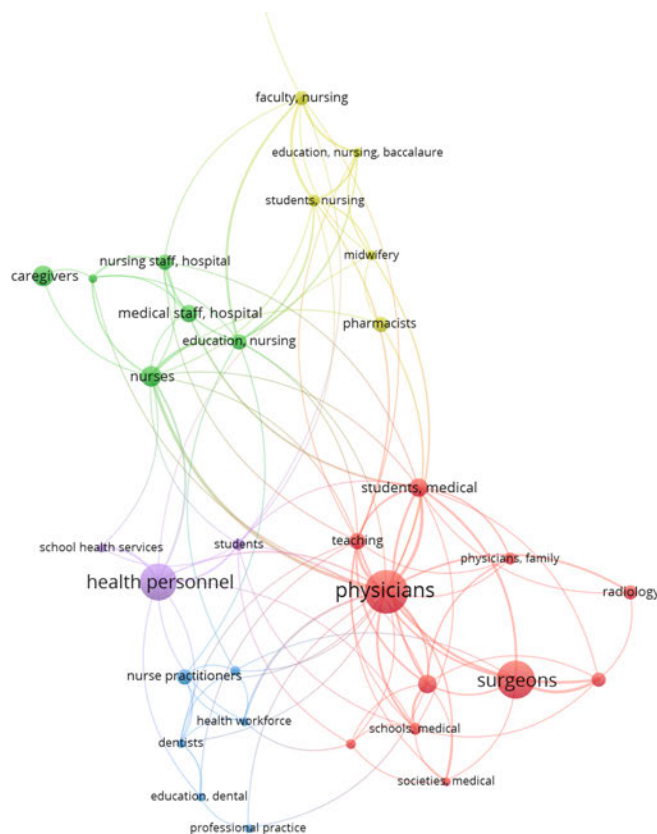

Figure 2. Co-occurrence of the terms associated with AI and professions (VOSviewer)

A significant observation is the early adoption of artificial intelligence (AI) in healthcare education within the medical profession in general, which experienced increased momentum after 2010. Subsequently, the nursing profession began to adopt AI in 2016, and its usage expanded to other healthcare professionals and medical specialties. (Fig.3).
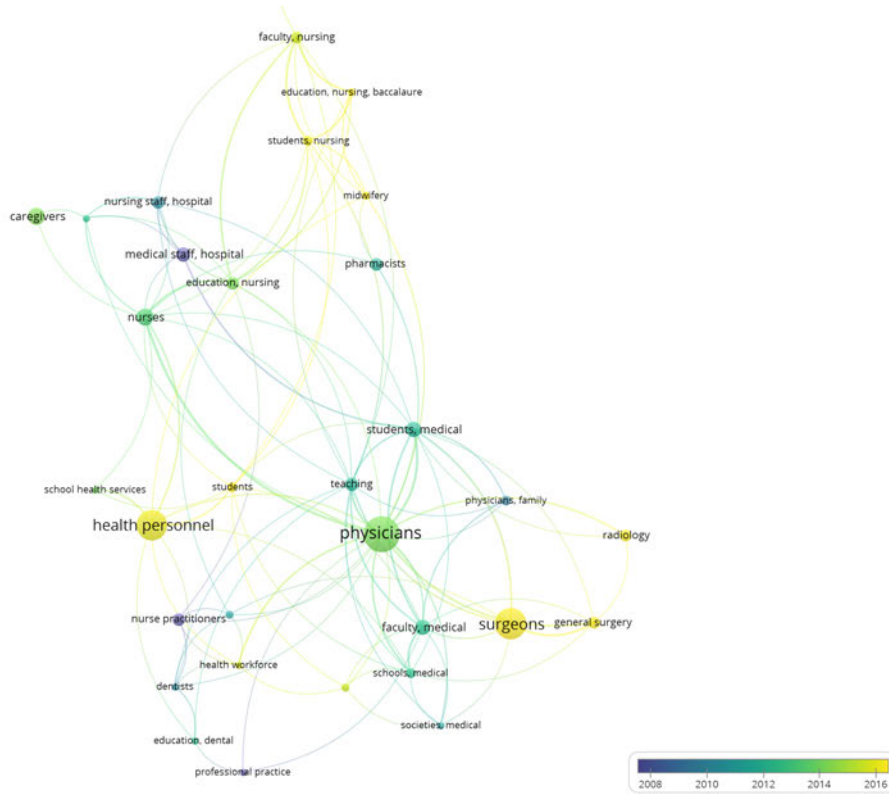
Figure 3. Co-occurrence of the terms associated with AI and professions trough time (VOSviewer)

In the context of applications of artificial intelligence (AI) in healthcare education, it is evident that the primary focus areas are associated with the enhancement of clinical competencies and attitudes among healthcare professionals, which include medical practitioners, nursing staff, and allied health personnel. Subsequently, patient education emerges as another significant aspect, encompassing health literacy and attitudes towards healthcare management (Fig.4).
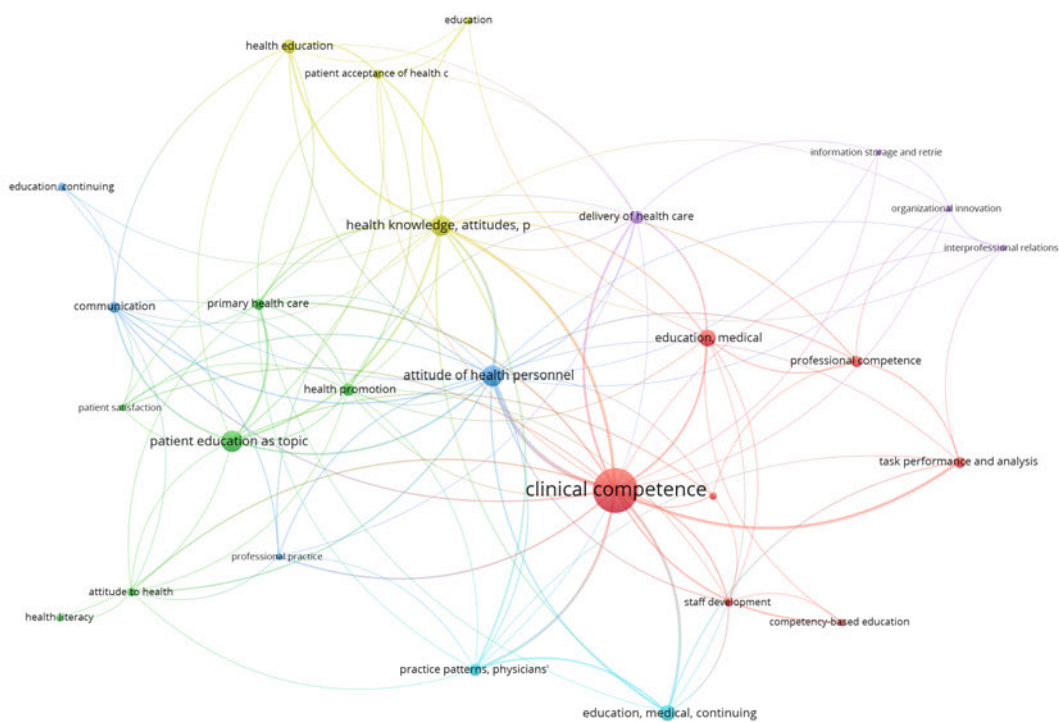

Figure 4. Co-occurrence of the terms associated with the AI usage in education (VOSviewer)

With respect to the adoption timeline of artificial intelligence (AI) in education, it is apparent that there was a marked increase in interest regarding its potential as a tool for enhancing clinical competencies after 2016. However, the utilization of AI for patient education purposes can be traced back to earlier years, indicating a gradual progression in the integration of AI technologies within the healthcare education domain (Fig.5).
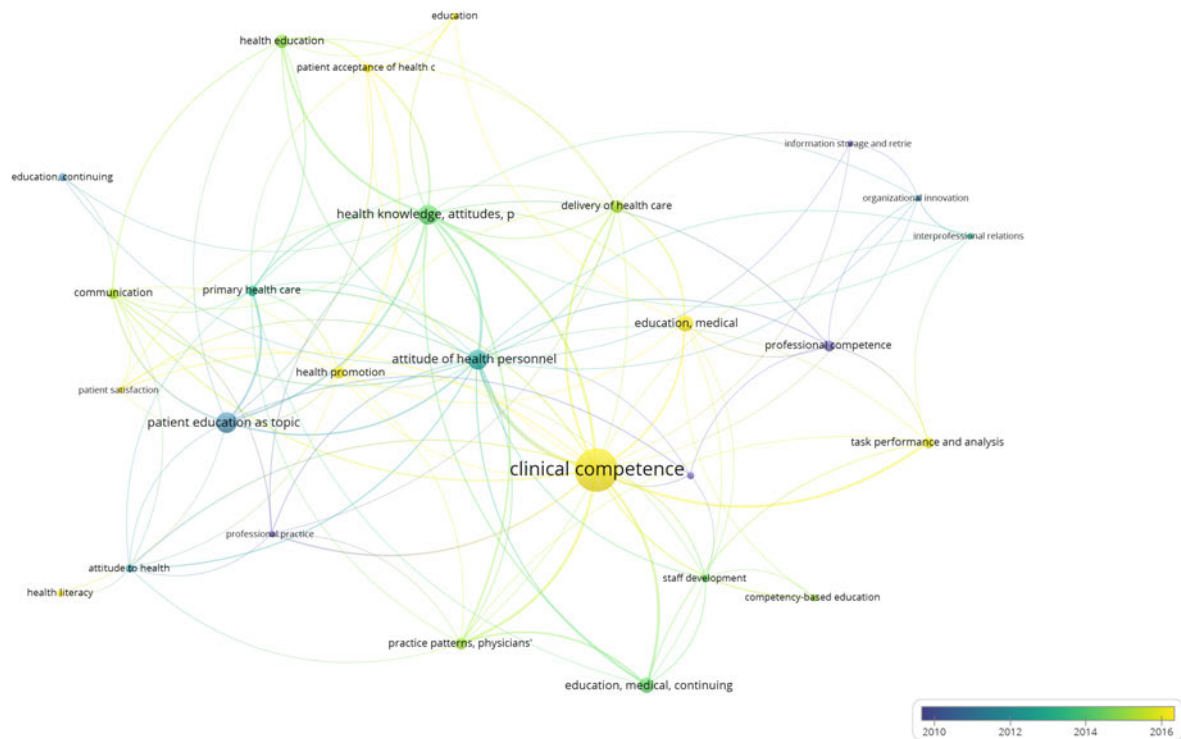

Figure 5. Co-occurrence of the terms associated with the AI usage in education trough time (VOSviewer)

4   CONCLUSIONS

In recent years, as demonstrated by published research, interest in artificial intelligence (AI) has grown exponentially, impacting various aspects of its implementation in the education and training of healthcare professions. This surge in interest can be attributed to advancements in AI technology, such as machine learning, deep learning, and natural language processing, which have broadened the potential applications and benefits of AI in healthcare education.

The integration of AI in healthcare education has the potential to augment the learning experience for students, refine their clinical skills and decision-making abilities, and ultimately contribute to improved patient outcomes. As AI technology develops further, it is crucial to ensure that these innovations are designed and implemented in an ethical and responsible manner, with due consideration given to issues such as bias, privacy, and transparency.

As healthcare education continues to adopt AI technology, interdisciplinary collaboration between AI researchers, educators, and healthcare professionals will be essential to address potential challenges and to maximize the benefits of AI for students and patients alike. By working together, stakeholders can help shape the future of healthcare education and ensure that AI technology is harnessed effectively and responsibly to promote better patient care and outcomes.

REFERENCES

[1]   K. Gray, J. Slavotinek, G. L. Dimaguila, and D. Choo, 'Artificial Intelligence Education for the Health Workforce: Expert Survey of Approaches and Needs', *JMIR Med. Educ.*, vol. 8, no. 2, p. e35223, Apr. 2022, doi: 10.2196/35223.

[2]   Pr. Shankar, 'Artificial intelligence in health professions education', *Arch. Med. Health Sci.*, vol. 10, no. 2, p. 256, 2022, doi: 10.4103/amhs.amhs_234_22.

[3]   K. S. Chan and N. Zary, 'Applications and Challenges of Implementing Artificial Intelligence in Medical Education: Integrative Review', *JMIR Med. Educ.*, vol. 5, no. 1, p. e13930, Jun. 2019, doi: 10.2196/13930.

[4]   M. José Sousa, F. Dal Mas, A. Pesqueira, C. Lemos, J. Manuel Verde, and L. Cobianchi, 'The Potential of AI in Health Higher Education to Increase the Students' Learning Outcomes', *TEM J.*, pp. 488–497, May 2021, doi: 10.18421/TEM102-02.

[5]   A. M. Fazlollahi *et al.*, 'Effect of Artificial Intelligence Tutoring vs Expert Instruction on Learning Simulated Surgical Skills Among Medical Students: A Randomized Clinical Trial', *JAMA Netw. Open*, vol. 5, no. 2, p. e2149008, Feb. 2022, doi: 10.1001/jamanetworkopen.2021.49008.

[6]   'Unleashing the power of AI for education', *MIT Technology Review*. https://www.technologyreview.com/2020/03/04/905535/unleashing-the-power-of-ai-for-education/ (accessed May 05, 2023).

[7]   L. Rouhiainen, 'How AI and Data Could Personalize Higher Education', *Harvard Business Review*, Oct. 14, 2019. Accessed: May 05, 2023. [Online]. Available: https://hbr.org/2019/10/how-ai-and-data-could-personalize-higher-education

[8]   R. Charow *et al.*, 'Artificial Intelligence Education Programs for Health Care Professionals: Scoping Review', *JMIR Med. Educ.*, vol. 7, no. 4, p. e31043, Dec. 2021, doi: 10.2196/31043.

[9]   J. M. Berger and C. M. Baker, 'Bibliometrics: An Overview', *Rajiv Gandhi Univ. Health Sci. J. Pharm. Sci.*, vol. 4, no. 3, pp. 81–92, Nov. 2014, doi: 10.5530/rjps.2014.3.2.

[10]   O. Ellegaard and J. A. Wallin, 'The bibliometric analysis of scholarly production: How great is the impact?', *Scientometrics*, vol. 105, no. 3, pp. 1809–1831, Dec. 2015, doi: 10.1007/s11192-015-1645-z.